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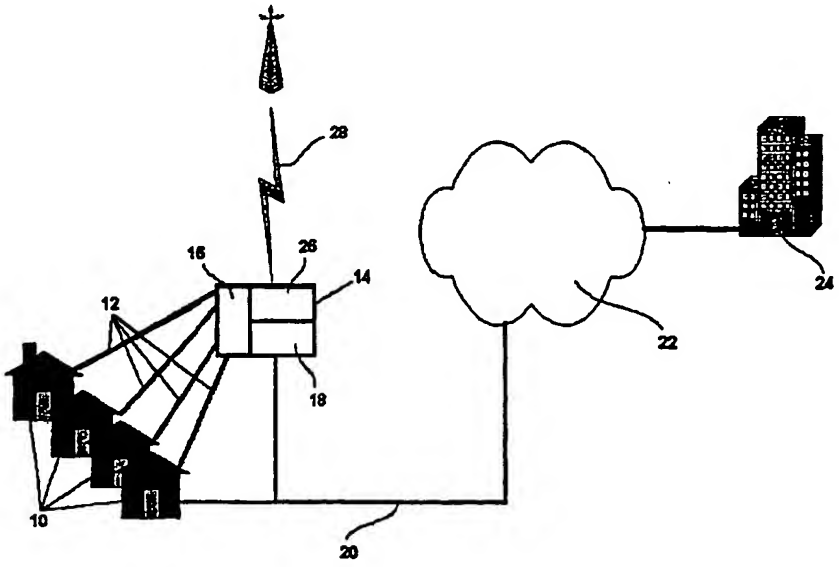
(54) Title: INTERACTIVE SYSTEM FOR REMOTE READING OF UTILITY METERS



(57) Abstract: A remotely interactive metering system comprises a plurality of meter reading collection hubs (14) connected via a telecommunications network to a centralised meter reading server (24), each meter reading collection hub (14) being connected to a plurality of sensing means for interfacing with a meter and providing an output signal corresponding to the meter reading, the meter reading collection hub including communication means (26) for receiving real-time time signals (28) which are used to synchronise transmission of data from the meter reading collection hub (14) to the centralised meter reading server (24).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERACTIVE SYSTEM FOR REMOTE READING OF UTILITY METERS

The present invention relates to a remotely interactive metering system and in particular to a system for automatically reading utility or other forms of meter.

According to one aspect of the present invention, a remotely interactive metering system comprises:

sensing means for interfacing with a meter and providing an output signal corresponding to the meter reading;

a meter reading collection hub connecting to said sensing means of several meters, the meter collection hub comprising:

means for converting the output signal from each sensing means and providing a count for each meter associated with each one of said sensing means;

telecommunication means by which data may be transmitted from the meter reading collection hub to a centralised meter reading server; and

communication means by which the meter reading collection hub may receive real-time, time signals; and

a centralised meter reading server.

The sensor means may be an integral part of the meter or may be located externally of the meter. For example, in the case of electricity meters, the sensor means may be situated within easy sensing distance from the rotating disc of the meter. Alternatively, if the meter is provided with an external terminal for reading the units consumed, then this external terminal may be connected to the meter reading collection hub. With meters having a LED display, the sensors may pick up the LED signalling.

In addition to means for sensing the meter reading, the sensor means may

also comprise means of sensing the direction of rotation and jitteriness. In electricity meters, a disc is located inside electricity meter and rotates freely due to magnetic fields and forces applied upon it through a set of coils mounted inside the meter. Rotation of the disc will clock the amount of consumption of electricity. A reflective silver material and marker set on the side of the disc is detected by a light sensor, to detect the position of the disc. A combination of two of these light sensors will detect the direction of rotation of the disc.

The sensing of rotational movement will be confirmed only when both sensors have detected the marker located on the disc. A unit consumed will be registered only when both of the sensors have recorded the marker.

In normal operational circumstances, the disc jitters, moving backwards and forwards, when the meter is operating with hardly any load carried through it, ie minimal consumption of electricity. The sensors will register a directional rotation only when both of the sensors have simultaneously recorded the marker. Then, one unit of consumption will be registered. This will prevent the false registration of multiple units consumed due to jitteriness of the disc in low load application.

Typically, up to seven meters may be connected to each meter reading collection hub. These meters may be any kind of meters and/or meters for different utilities, for example electricity, water or gas serving one household and/or may be meters for the same utility from several neighbouring households.

Multiplexing may increase the number of meters that may be connected to each meter reading connection hub, to for example 64, where higher densities of meters occur, for example for blocks of flats or industrial

premises.

The meter reading collection hub utilises digital decimal odometers for unit counting. These digital decimal odometers comprise a set of wheels, each of one millimetre in depth. Each wheel has a set of four grooves of an equal length punched through its surface. The outer ring groove lengths are split into two halves. The first half runs parallel to the first inner ring groove and the second half runs alone across its sector. The lengths of these grooves are spread equidistantly on the surface of one sector without grooves. Their position is spread equally, and distance apart, at the same intervals as the groove reader mounted on the reader arm. The width of each groove is wide enough to allow a narrow beam of laser or light ray to penetrate. The grooves will enable that wheel to represent figures 0 - 9 digitally encoded.

These digital decimal odometers are fixed with gears which are attached to counter visual dials. This arrangement enables both the visual display of numeric counting and the representation of these decimal numbers electronically.

The number of these wheels will match exactly the number of dials displayed on the display unit counter, so for example if there are nine sets of display dials on the electricity meter, then there will be nine sets of these digital decimal odometers.

These digital decimal odometers can provide electronically the amount of units consumed instantly at any time. The mechanical devices will eliminate the need for a battery in case of power deprivation. They can be mounted inside a meter or can be driven by pulses from a microprocessor in a separate box to the meter.

The meter reading collection hub may also be provided with means for recording the readings and storing them temporarily, for subsequent transmission via telecommunication system to the centralised meter reading server. Moreover, processing means may be provided to calculate and store consumption rates, so that the system may predict unmetered uses from previous recordings and establish normal consumption pattern. In this manner, deviations from the normal consumption patterns may be reported prompting further enquiries from the utility board in order to avoid possible fraudulent activities.

The normal PSTN line of one of the household's or a dedicated PSTN line may be used for sending data from the meter reading connection hub to the centralised meter reading server. Alternatively, terrestrial or satellite GSM and its associated signalling protocols may be provided in the meter reading connection hub for this purpose via the Internet.

The telecommunication means may operate as a meter server with auto-dial to a specified telephone number or a meter server with auto-answering on a specific count of telephone rings.

Password protection may also be provided which may be set and altered by the utility board to provide data protection and ensure integrity.

TCP/IP mode for the meter reading collection hub, using a combination of a unique IP address and customer house telephone line or a GSM number, provides a unique identification address. The communication layers for this mode consist of the following:-

Connection to the customer household telephone line with dial-up facility with a fixed number of tries to dial the utility computer site using a free phone number, and after the 'Economy 7' radio signal has triggered the transmission process. Alternatively using the hub

GSM protocols for instance GPRS, to enable the centralised meter reading server to start a GPRS session using a PSTN line and/or the Internet to download the hub readings.

The initial state of the system will have TCP/IP stack loaded into its RAM from the ROM when initially switched on. The TCP/IP stack will have class C address initially for any trial period. This network is a private one and does not have an Internet access. The IP address will be encoded by hardware or software means (via a password protected serial port). The IP address range could then be changed to a registered bigger range (for instance class A) when the system is accepted and in full production.

The system uses an FTP (file transfer protocol) application within the TCP/IP suite to transfer the reading back to the host system database, and shut down the connection (telephone line).

The centralised meter reading server consists of a modem rack with several modems, TCP/IP stack loaded, and should be configured as a FTP server with a database application running. Modification, editing and billing can be done from the database.

The communication means for receiving real time, time signals, is preferably a radio communication means which may pick up real time, time signals such as "Radio 4" or the "Rugby signalling system". Alternatively the electricity boards "Economy 7" signal may be used for this purpose.

The real time, time signal is used to synchronise communications of data between the meter reading collection hubs and centralised meter reading server. In addition the real time signal may be used for switching unit

consumption rates, for day/night rating, with seasonally adjusted timing.

The meter reading collection hub is preferably empowered by mains electricity. A battery backup system is however preferably provided to maintain operation during power cuts and to avoid loss of data. The battery backup is preferably re-chargeable so that when power is restored, the battery may be re-charged.

Non-volatile storage media, for example SIM media may also be used to store data.

The meter collection hub may also report to the utility the occurrence and duration of power cuts.

The digital decimal odometers may also act as visual dials allowing visual reading of the meter.

Meter centre calibration units may also remotely display and test the meter sensors accumulative disc revolutions, units consumed, kilowatts and fractions of kilowatts.

The system according to the present application allows direct and accurate collection of meter readings, without any delay, at any time, so that:-

a) precise readings of consumed units may be quoted on customer bills, rather than estimated consumed units;
b) meter readings can be collected 24 hours a day, 7 days a week, without disturbing the occupants of the buildings;
c) the utility billing time cycle is minimised;
d) the utility may provide customers with multiple choice of rate consumption, not only bound by the "Economy 7" rate but

provide other rates to satisfy customer needs;

e) provide cost effectiveness in the following areas:-

i) maximum utilisation of human resources and equipment;

ii) car purchasing or leasing;

iii) fuel;

iv) maintenance;

v) inflation cost linked to the above points;

vi) elimination for the need to use resource in order to collect meter readings.

The system covered the present application also provides the following advantages:-

a) remote access and bidirectional communication control over non half-hourly monitoring and meter reading;

b) reporting of powercuts and fraudulent activity immediately;

c) empowers the utility to offer better customer care by offering variety of rates and precise billing;

d) use of existing meters and public telephone networks, all the technology used is in use and reliable;

e) unlimited meter reading collection at will, 24 hours a day 7 days a week;

f) adhering to OFFER's guidelines in protecting the consumer's interests;

g) adhering to British approved industrial standards British manufacturing standards (BS9000);

h) accurate and precise meter readings for billing the consumer, no estimate readings, with single database for customer's information;

i) environmentally friendly, will encourage the reduction of burning fossil fuels with offering a cheap way of monitoring

consumption at will and cutting cost of collecting meter readings;

j) minimal and cost effective installation time and minimal running costs;

k) allowing effective utilisation of manpower;

l) design adaptable to meet utility board specifications;

m) low cost operation and maintenance.

While the system has been described with reference to meters for utilities in general and electricity in particular, the system may also be used for other metered commodities, for example fuel, vending machines or taxi services.

The invention is now described, by way of example only, with reference to the accompanying drawings, in which :-

Fig. 1 is a diagrammatic illustration of one embodiment of the present invention; and

Fig. 2 is a diagrammatic illustration of an alternative embodiment of the invention.

As illustrated in Fig. 1 a remotely interactive metering system includes a series of meter reading collection hubs 14 (only one shown). The meter reading collection hubs 14 are connected via cables 12, each to a plurality of sensing means (not shown) for reading utility meters in a plurality of neighbouring households 10.

The meter reading collection hub 14 includes means 16 for converting and processing the signals from each of the sensing means, into counts for each of the meters associated therewith and for temporarily storing the

data.

The meter reading collection hub 14 also includes telecommunication means 18 which is connected to a telephone line 20 of one of the households 10, by which it is connected to the PSTN network and via that to a centralised meter reading server 24.

The meter reading collection hub 14 also has radio receiving means 26, by which it may receive real-time, time signals 28.

Means 16 continuously monitors the meters connected thereto, calculating total consumption and consumption rates and storing the data for subsequent transmission to the centralised meter reading server 24. This data is transmitted by telephone line 20, at specific times, the timing being synchronised by the real-time signal 28. The real-time signal may furthermore be used to switch means 16, for different charge rates, for example "Economy 7" thereby taking into account seasonally adjusted timing.

In a modification illustrated in Fig. 2, the sensor means are connected to the meter reading collection hub 14 via multiplexing means 30, so that the number of meters connected to the hub 14 may be typically increased from 7 to 64.

Moreover, in the embodiment illustrated in Fig. 2, the meter reading collection hub 14 is connected to the PSTN network and thus to the centralised meter reading server 24, by means of a GSM satellite signal 36, thereby avoiding the need to use a customer telephone line. Alternatively, a GSM terrestrial signal may be used.

CLAIMS

1. A remotely interactive metering system comprising:
sensing means for interfacing with a meter and providing an output signal corresponding to the meter reading;
a meter reading collection hub connecting to said sensing means of several meters, the meter collection hub comprising:
means for converting the output signal from each sensing means and providing a count for each meter associated with each one of said sensing means;
telecommunication means by which data may be transmitted from the meter reading collection hub to a centralised meter reading server; and
communication means by which the meter reading collection hub may receive real time, time signals; and
a centralised meter reading server.

2. A remotely interactive metering system according to Claim 1 in which a plurality of meter reading collection hubs are connected to the centralised meter reading service by telecommunications means.

3. A remotely interactive metering system according to Claim 1 or 2 in which the sensor means is an integral part of the meter.

4. A remotely interactive metering system according to Claim 1 or 2 in which the sensor means is located externally of the meter.

5. A remotely interactive metering system according to Claim 3 or 4, in which the sensor means is situated within easy sensing distance from a rotating disc of the meter.

6 A remotely interactive metering system according to Claim 1 or 2 in which the meter reading collection hub is connected to an external terminal of the meter.

7. A remotely interactive metering system according to any one of Claims 1 to 5 in which the sensor means senses LED signalling from an LED meter display.

8 A remotely interactive metering system according to any one of Claims 3 to 7, in which the sensor means includes means for detecting the direction of rotation and jitteriness of a rotating disc of the meter.

9. A remotely interactive metering system according to any one of the preceding claims in which the sensors connected to the meter reading collection hub are meters for different utilities of a single premise and/or meters for the same utility of several neighbouring premises.

10. A remotely interactive metering system according to any one of the preceding claims in which multiplexing means is provided between the sensing means and the meter reading collection hub, to increase the number of sensing means which may be connected to the meter reading collection hub.

11. A remotely interactive metering system according to any one of the preceding claims in which the meter reading collection hub utilises digital decimal odometers to convert the signals from the sensing means into unit counts.

12. A remotely interactive metering system according to Claim 10 in which the digital decimal odometers are coupled to display dials to provide a visual display.

13. A remotely interactive metering system according to any one of the preceding claims in which the meter reading collection hub comprises means for recording the readings and storing them temporarily, for subsequent transmission via telecommunication system to the centralised meter reading server.

14. A remotely interactive metering system according to Claim 13 in which the meter reading collection hub is provided with processing means to calculate and store consumption rates, predict unmetered uses from previous recordings and establish normal consumption pattern.

15. A remotely interactive metering system according to Claim 14, in which the meter reading collection hub can report deviations from normal consumption patterns.

16. A remotely interactive metering system according to any one of the preceding claims in which the metering reading collection hub is connected to the centralised meter reading server by the PSTN network.

17. A remotely interactive metering system according to Claim 16, in which the meter reading collection hub is connected to the PSTN network by the telephone line of the household served by the meter reading collection hub.

18. A remotely interactive metering system according to any one of Claims 1 to 15, in which the meter reading collection hub is connected to the centralised meter reading server via terrestrial or satellite GSM signalling means.

19. A remotely interactive metering system according to any one of Claims 1 to 15, in which the meter reading collection hub is running

TCP/IP and connected to the centralised meter reading server via Internet/PSTN/terrestrial or satellite (GSM) signalling means.

20. A remotely interactive metering system according to any one of Claims 16 to 18, in which the telecommunication means operates as a meter server with auto-dial to a specified telephone number.

21. A remotely interactive metering system according to any one of Claims 16 to 18, in which the telecommunication means operates as a meter server with auto-answering on a specific count of telephone rings.

22. A remotely interactive metering system according to any one of the preceding claims in which the telecommunication means is password protected.

23. A remotely interactive metering system according to any one of the preceding claims in which the communication means by which the meter reading collection hub receives real-time signals, comprises a radio receiver.

24. A remotely interactive metering system according to Claim 23, in which the communication means receives real-time time signals such as "Radio 4" or the "Rugby Signalling System".

25. A remotely interactive metering system according to any one of Claims 1 to 22, in which the communication means receives Economy 7 signals.

26. A remotely interactive metering system according to any one of the preceding claims, in which the real-time time signal is used to synchronise communications of data between the meter reading collection hubs and a

centralised meter reading server.

27. A remotely interactive metering system according to any one of the preceding claims, in which the real-time time signal is used for switching unit rates.

28. A remotely interactive metering system according to any one of the preceding claims in which the meter reading collection hub has back-up battery means.

29. A remotely interactive metering system according to any one of the preceding claims in which the meter reading collection hub has non-volatile storage media.

30. A remotely interactive metering system according to any one of the preceding claims in which the meter reading collection hub can report the occurrence and duration of power cuts.

31. A remotely interactive metering system according to any one of the preceding claims for use in connection with meters for utilities, electricity, gas and water, or for other metered commodities, for example fuel, vending machines or taxi services.

32. A remotely interactive metering system substantially as described herein, with reference to and as shown in Figs. 1 and 2 of the accompanying drawings.

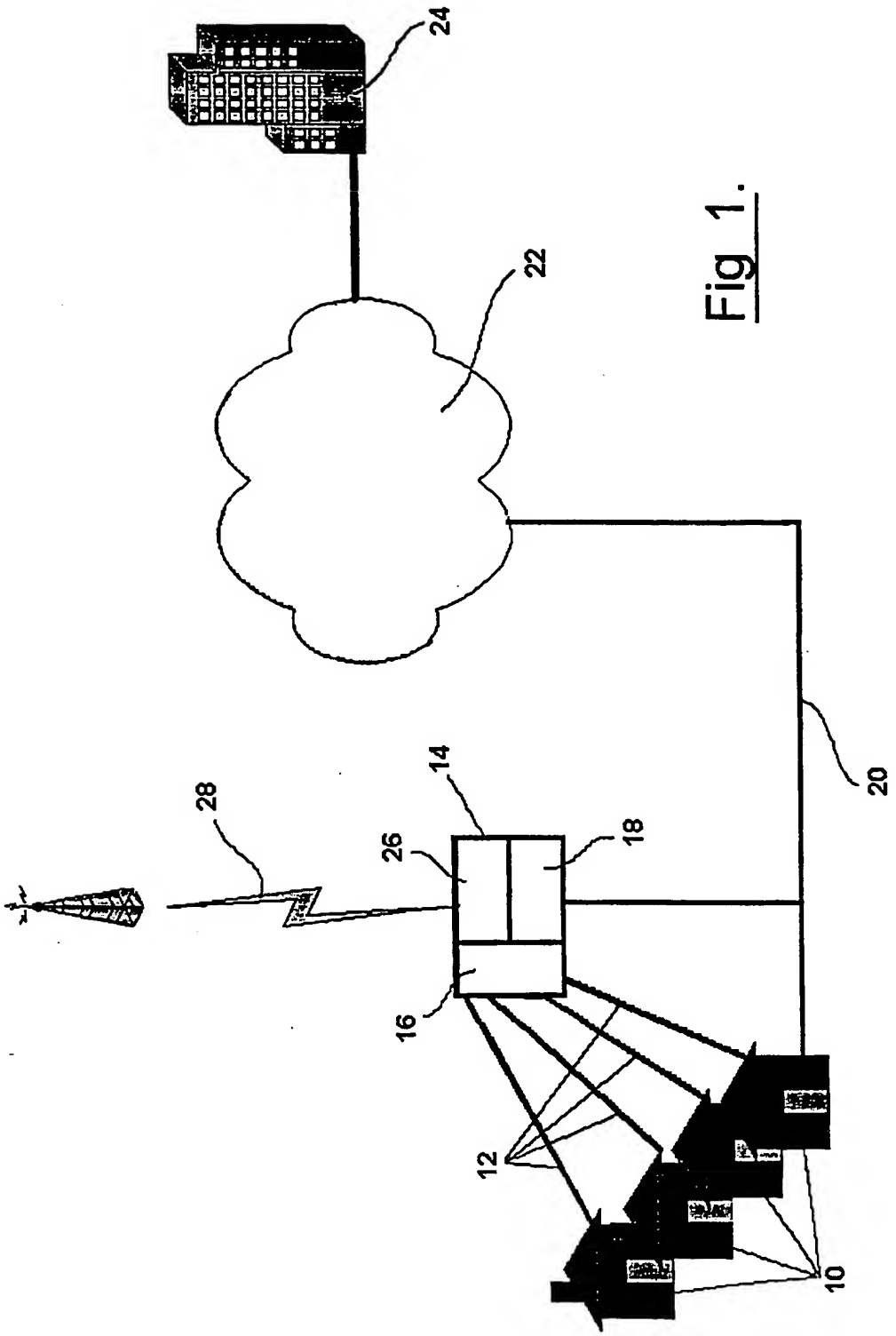


Fig 1.

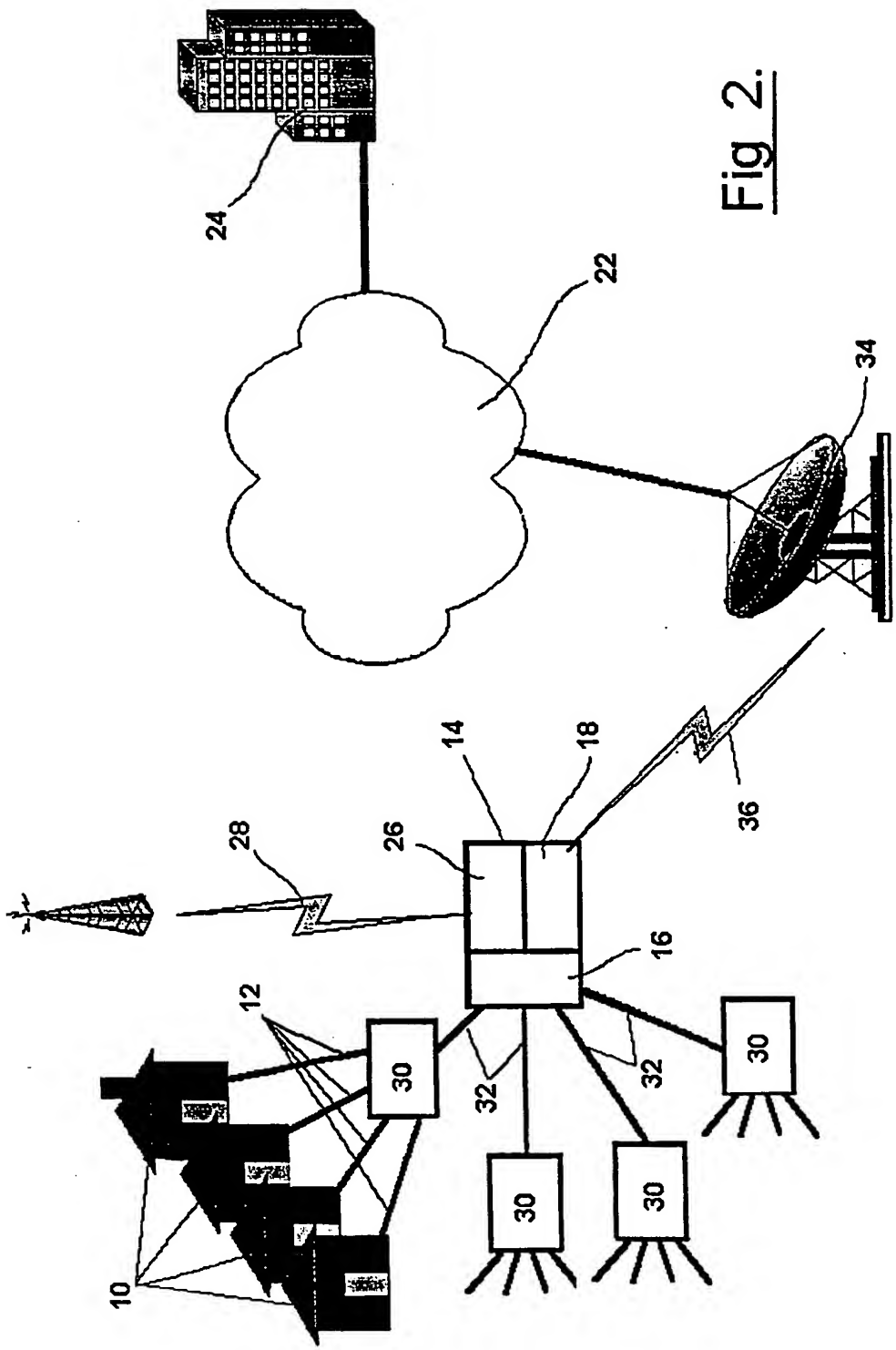


Fig 2.

INTERNATIONAL SEARCH REPORT

Interna al Application No
PCT/GB 00/03231

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G08C17/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G08C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 892 758 A (ARGYROUDIS PANAYOTIS) 6 April 1999 (1999-04-06) column 4, line 35 -column 6, line 40 column 9, line 1 - line 24 column 10, line 21 -column 11, line 9 column 16, line 11 -column 17, line 38 ---	1-6,9, 11,13, 16-18, 23,26, 29-32
X	EP 0 629 098 A (LOGICA UK LTD) 14 December 1994 (1994-12-14) column 3, line 35 -column 4, line 32 column 5, line 8 -column 6, line 33 column 7, line 44 -column 10, line 18 --- -/--	1-3,6,9, 13-17, 23, 26-28, 30-32

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 December 2000	27/12/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Pham, P

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INTERNATIONAL SEARCH REPORT

Intern. al Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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